Memorandum of Agreement

Between the

National Aeronautics & Space Administration (NASA)

Independent Verification and Validation Facility

And

EOS Aura Project

_____   3/29/01
_____
Margaret Luce   Date
Aura Project Manager

_____   3/30/01
_____
Judith Bruner   Date
Director, NASA IV&V Facility

_____   4/04/2001
_____
Marcus S. Fisher   Date
Project Manager, NASA IV&V Facility

1. Purpose

This Memorandum of Agreement (MOA) is between the NASA Independent Verification and Validation (IV&V) Facility, Goddard Space Flight Center (GSFC) Code 307, and the EOS Aura Project, Code 424. It documents the working relationship, roles and responsibilities, and points of contact necessary to assure mutual benefits to the parties involved. Individual tasks, along with receivables/deliverables and resources are identified and documented in the sections that follow.

2. Scope

The scope of this MOA is to define the tasks, points of contact, schedule, resources, and responsibilities between the IV&V Facility and the Aura Project. The work defined by this MOA will support the Aura Project Office to perform Software IV&V of the EOS Aura mission by the IV&V Facility.

The objectives of the IV&V activity are to:
- Identify any software failures that can cause permanent loss of an instrument, or loss of communication between an instrument and the spacecraft, and ensure that the associated software is adequately tested,
- Ensure that tests for the Aura specific spacecraft software changes are robust and complete,
- Because of the commonality of software between Aqua and Aura, ensure that the test program for the Aqua spacecraft flight software is sufficient and will result in reliable software for Aura.

3. Duration of the MOA

This MOA shall be in effect until the completion of the agreed tasking or until terminated at the request of one or both parties.

4. Schedule

The schedule is as follows:
- IV&V Facility will begin its activities February 1, 2001.
- IV&V Facility will complete its activities March 1, 2003.

5. Points of Contact

The following points of contact have been established for this MOA.

	Name	Voice	Fax
NASA IV&V Facility:			
IV&V Facility Director	Judith Bruner	304-367-8201	304-367-8203
IV&V Project Manager	Marcus S. Fisher	304-367-8337	304-367-8203
IV&V Financial Manager	Donna Ozburn	304-367-8234	304-367-8203

Aura Project

Aura, Project Manager	Margaret Luce	301-286-6527	301-286-1742
Aura, IV&V Liaison	Carver Audain	301-286-2501	301-286-1742
Aura, Deputy Project Manager for Resources	Suzanne Gallagher	301-286-8646	301-286-1742

6. Roles and Responsibilities

6.1 NASA IV&V Facility

The NASA IV&V Facility personnel will provide the technical direction and financial management for the civil servants and IV&V contractors to perform the tasks listed in this Task Agreement. These civil servants and contractors are located at the IV&V Facility and GSFC. The IV&V Project Manager (PM) will be responsible for the direction and activities performed by the IV&V contractors and for planning and approving the work to be performed. The IV&V PM will ensure that the work being performed falls within the scope of this MOA.

The IV&V PM is responsible for assuring transmittal of the IV&V deliverables identified in Section 8 to the Aura Project. The IV&V PM will be the formal interface between the IV&V contractors, the Aura Project Office, and the Aura development organizations for issues related to the IV&V work being performed for the Aura project.

Any interactions with the Aura development organizations initiated by the IV&V Facility personnel shall be coordinated through the Aura Project Office. The IV&V PM shall not provide any technical direction directly to the Aura development organizations. The IV&V PM shall make requests to the Aura Project Office for any work required by the Aura development organizations. The IV&V PM shall make requests to the Aura Project Office for any access to the facilities of the Aura development organizations.

The IV&V PM must ensure that no proprietary material be released to contractor personnel unless a non-disclosure agreement with the contractor's corporate office is accepted.

The IV&V Facility conducts research in the areas of: software reliability measurement, requirements analysis, IV&V return on investment, as well as other areas which directly contribute to the effectiveness of IV&V. IV&V Facility researchers require actual project data to accomplish realistic research. All project data shall be closely protected and shall not be released outside the IV&V Facility and its research contractors. Research papers published by the facility shall not reference a project by name or publish any information that could be traced back to the project. Contractor proprietary data shall not be used to support IV&V research. The IV&V facility shall not publish, or allow publication of, any research document that can be referenced back to Aura without specific prior written approval of the Aura Project Manager. The IV&V Facility shall accept data in the Aura Project's format and shall not impose a burden on the Project to produce or generate special data for the IV&V research.

6.2 Aura Project

The Aura Project will facilitate the tasks to be performed with the IV&V Facility. This may involve coordination between project personnel and the IV&V facility (as required) to:
1) Provide IV&V personnel access to facilities to perform the IV&V tasks.
2) Provide necessary supporting documentation to the IV&V personnel to perform the IV&V tasks.
3) Transfer the funding as cited herein to GSFC to fund this activity.

The Aura Project agrees that Aura-related data may be used to support software IV&V-related research.

7. Tasks

The Facility shall perform the following IV&V activities (which shall consist of the review of documentation) for the Aura Project Office:

7.1 Perform detailed Criticality Analysis and Risk Assessment (CARA) of the Aura unique Spacecraft Software and Instrument Software focusing on the design, implementation, and testability of the developed software. For the spacecraft flight software the initial CARA shall focus on only those requirements that have been specifically added or modified for Aura. For the Instrument software, the initial CARA shall focus on the software design and implementation for each instrument. The result of the CARA is a list of Catastrophic/Critical/High Risk (CCHR) Functions, which shall be used to direct and facilitate the IV&V activities in a manner that is consistent with the scope of this document.

7.2 Perform Software Test Analysis on the spacecraft and the instrument flight software as directed by the CCHR listing, unless otherwise stated. Aspects of this analysis shall include:
1) Verify that test definitions, objectives, plans and acceptance criteria are sufficient to validate software requirements and operational needs associated with CCHR functions;
2) Review hazard and safety analyses and hazard trees;
3) Verify test case traceability and coverage of software requirements, operational needs and capabilities. For the spacecraft software, the focus of the analysis shall be directed by the results of the CCHR as well as the results of analyses performed on the software inherited from Aqua;
4) Verify that the test case definition inputs, expected results, and evaluation criteria contained in the Software Test Description (STD) document comply with Software Test Plan (STP) and objectives;
5) Analyze the process for dispositioning software test anomalies, and verify that the process is correctly implemented;
6) Validate the compliance of software test results with test acceptance criteria;
7) Verify the applicability of test cases to the requirements that they cover, and the successful completion of all software test case objectives;
8) Verify that the software test environment plans and designs meet software testing objectives;
9) Verify that regression tests are sufficient to determine that the IAM and the spacecraft heritage software are not adversely affected by the changes implemented to meet new requirements;

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10) Analyze the adequacy of the test setup, test execution, and test data collection procedures contained in the STD. This activity shall only apply to the spacecraft software.

7.3 Perform Interface Analysis on the spacecraft and instrument Interface Requirements Specifications and Interface Control Documents. Aspects of this analysis shall include, but are not limited to, the following:

1) Verify the quality and completeness of Interface Control Documents (ICDs) and their proper definition of protocols and message/event scheduling. Verify that there are project-unique identifiers for data elements, and that the proper software module is identified as the source of the data element. Verify that software modules that use the data element, units of measure, limits/ranges, and accuracy required of the data element are identified; and

2) Verify that the ICDs completely cover the requirements stated in the Interface Requirements Specification (IRS).

7.4 Perform System Test Analysis. Aspects of this analysis shall include, but are not limited to, the following:

1) Analyze STPs to verify that test definitions, objectives, verification methods and acceptance criteria are sufficient to validate system requirements and operational needs;

2) Verify test case traceability and coverage of system requirements, operational needs, and capabilities. This activity shall be driven by the results of the CCHR, Aura Project inputs, and the results of analyses on the heritage software;

3) Analyze the process for dispositioning system test anomalies, and verify that it is correctly implemented;

4) Validate the compliance of software test results with system test acceptance criteria;

5) Verify the applicability of test cases to the requirements, and verify the successful completion of all system level test objectives;

6) Verify that regression tests are sufficient to determine that the heritage software is not adversely affected by the changes implemented to meet new requirements;

7) Verify that test definitions, objectives, plans, and acceptance criteria are sufficient to validate interface requirements and operational needs;

8) Verify that test procedures address and exercise: synchronization, protocols, invalid message passing, and priority levels for module interfaces;

9) Verify that all technical software aspects of the interface are addressed by the software requirements; and

10) Verify that system test procedures address the findings from the Interface Analysis and/or Software Test Analysis.

8. Deliverables

The IV&V Facility shall provide the results of the IV&V analyses, identified issues and risks, as well as status reports, to Aura Project Management per the following table. (Note: issues and problems shall be immediately communicated to Aura Project Management, i.e. the IV&V Team shall not wait for the formal Review and Analysis Reports to begin the issue resolution process).

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Product	Recipient	Schedule
IV&V Technical Issues	Cognizant Aura project development team or organization, and the Aura Project Manager	Ad-hoc, as authored
Status Reports	Aura Project Manager	Monthly
Technical Reports	Aura Project Manager	Concluding each phase of IV&V activities. (i.e. at the end of the initial CARA a technical report will be delivered to the Aura project, at the end of performing software test analysis on the spacecraft software, et cetera - see sections 7.1, 7.2, 7.3, and 7.4)

9. Resources/Budget

9.1 Aura Project Resources

The following Aura Project resources (at GSFC, TRW, LMSS, JPL, and Litton Amecom) shall be made available (on a noninterference basis in accordance with the Work Implementation Plan developed by the IVVF Facility) to the IV&V Team:
1) Access to the Aura Project Office internal web site;
2) Access to the Aura development, test, and implementation facilities for the purpose of reviewing work products and evaluating tests;
3) Access to development and test computing environments and tools on an as available basis for the purpose of special analyses;
4) Access to problem tracking and Configuration Management Systems;
5) Area access permits for those areas that are accessed by Aura development and operations personnel; and
6) Access to all documentation required to complete the IV&V activities.

9.2 IV&V Resources

The following IV&V resources shall be made available to the Aura Project:
1) Access to all the results generated from Aura related IV&V activities;
2) Access to any analysis tools and models used for Aura related IV&V activities; and
3) Access to any IV&V internal web site that pertains to Aura.

9.3 Budget

The following budget is the cost for the IV&V effort on the Aura Project as described in this MOA. This budget includes all labor and materials costs for civil servant, contractor, facility, and travel:

Aura Project IV&V Costs

FY2001   Not to exceed $240,000

FY2002   Not to exceed $268,000

FY2003   Not to exceed $94,000